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Review

Nurse-coordinated home-based cardiac rehabilitation for patients with heart failure: A scoping review

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ABSTRACT

Objectives: This study aimed to review and summarize the studies of nurse-coordinated home-based cardiac rehabilitation for patients with heart failure.

Methods: The review was performed using Arksey and O'Malley's scoping review framework. A systematic search was conducted across eight databases, including PubMed, Embase, Web of Science, EBSCO, China Biomedical Literature Service System (SinoMed), China National Knowledge Infrastructure (CNKI), Wanfang Database, and Chinese Science and Technology Journals (CSTJ) Database, and Chinese Clinical Trial Registry, from inception to 30 April 2023. Articles relevant to the nurse-coordinated home-based cardiac rehabilitation for patients with heart failure were included.

Results: Eighteen studies were included in this review. These studies showed that nurses primarily focused on patient assessment, home-based cardiac rehabilitation planning and guidance, and follow-up. The studies also reported positive outcomes in patient safety, feasibility, and efficacy of the programs coordinated by nurses.

Conclusions: Home-based cardiac rehabilitation coordinated by nurses is beneficial to patients with heart failure. Future research will explore the potential of nurses in home-based cardiac rehabilitation for patients with heart failure, determine optimal evaluation criteria, and formulate safe, effective, and economical rehabilitation programs suitable for the patients.

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What is known?

- Patients with heart failure are at a higher risk of complications when engaging in physical exercise. There has been limited research that focused on home-based rehabilitation of patients with this condition.
- Nurses play a crucial role in health care of patients with heart failure, but their contribution to patients' home-based cardiac rehabilitation is ambiguous.

- Researchers tend to focus more on objective indicators during the assessment process, and few studies showed consideration of evaluating patients' subjective wishes.
- Nurses play an important supporting role in patient exercise management, but there is still scope for improvement in this area.
- Nurses have an irreplaceable role in follow-up care, but improving patient compliance remains a concern.

What is new?

- Home-based cardiac rehabilitation, coordinated by nurses, is safe, feasible and effective for patients with heart failure.

1. Introduction

Heart failure is the end stage of heart disease [1]. More than 64 million people are affected by heart failure globally [2]. The prevalence of heart failure in adults in China is more than 1.3%, and 8.9 million people suffer from heart failure [3]. Patients with heart failure are often repeatedly admitted to the hospital because of the poor self-management of risk factors at home, which reduces the quality of lives of patients, resulting in huge economic pressure on society and disease management pressure on the public health

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sector [4]. Physical inactivity and cardiorespiratory destruction have been identified as important risk factors for heart failure [5]. Cardiac rehabilitation is effective in improving cardiopulmonary function, exercise tolerance, and reducing readmission and mortality in patients with heart failure [6]. Exercise-based cardiac rehabilitation is recommended for patients with heart failure in the stable stage [1,7].

Currently, the development of cardiac rehabilitation is mainly carried out in outpatient clinics. However, the utilization rate of outpatient cardiac rehabilitation is less than 40% in most countries because of commuting difficulties, scheduling issues, and the lack of professional references [8,9]. In addition, patients who are older, lack social support, and are in less physical condition are more likely to miss outpatient cardiac rehabilitation [10]. During the COVID-19 pandemic, many cardiac rehabilitation institutions have closed, resulting in a further decline in the participation rate of outpatient cardiac rehabilitation for patients with heart failure [11]. Thus, patients with heart failure require a change of location for cardiac rehabilitation. Home-based cardiac rehabilitation (HBCR), which are mainly based in the community or home instead of hospitals, could enhance the participation rate of patients with heart failure in outpatient cardiac rehabilitation economically [12].

HBCR refers to the comprehensive guidance provided by medical staff to patients, including assessment, exercise management, diet management, drug management, psychological counseling, and risk factor management [12]. In comparison with outpatient cardiac rehabilitation, HBCR can support patients with heart failure in overcoming transportation challenges. In HBCR, patients can freely choose the time of their consultation, and both the medical and non-medical expenditures of cardiac rehabilitation for patients are low [13,14]. Therefore, the value of HBCR in patients with heart failure is worth exploring in depth.

Previous reviews have focused on the overall interventions and outcomes of HBCR, including a few details on specific roles such as nurses [15,16]. Although HBCR is a multidisciplinary program, nurses are the main force of HBCR because of the limited number of people in positions such as doctors, physical therapists, and dietitians [17]. Moreover, nurses play multiple roles, such as project managers, educators, and supervisors, in the self-management of patients with heart failure [18]. However, the HBCR for patients with heart failure is still in the initial stage in most countries, and the role of nurses in HBCR for patients with heart failure is unclear. This condition may have a negative effect on the quality and progress of HBCR by multidisciplinary teams in some nations. Nurses are core coordinators in disease management who can work independently or as members of teams. Accordingly, the collaborative research of nurses on HBCR for patients with heart failure was summarized herein for the comprehensive understanding of the role of nurses in the HBCR of patients with heart failure, enhancing the effectiveness of patient interventions, and advancing the field of rehabilitation nursing. This study aimed to summarize the studies on nurse-coordinated home-based cardiac rehabilitation for patients with heart failure.

2. Methods

This review was performed following the framework of Arksey and O'Malley: identifying the research question, identifying relevant studies, study selection, charting the data, and collating, summarizing, and reporting the results [19]. In addition, this study is reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines [20].

2.1. Identifying the research question

This scoping review focuses on the nursing-coordinated HBCR for patients with heart failure. The research questions were as follows: 1) What are the intervention contents of HBCR for patients with heart failure coordinated by nurses? 2) What is the effect of nursing-coordinated HBCR on patients with heart failure?

2.2. Identifying relevant studies

The PubMed, Embase, Web of Science, EBSCO, China Biomedical Literature Service System (SinoMed), China National Knowledge Infrastructure (CNKI), Wanfang Database, and Chinese Science and Technology Journals (CSTJ) Database were searched from their inception to 30 April 2023. We searched grey sources from the Chinese Clinical Trial Registry. MeSH terms and some free text terms were used to combine key terms. The key terms include: "Heart Failure/cardiac insufficiency/cardiac failure/cardiac dysfunction," "Cardiac Rehabilitation/Heart Rehabilitation/Home-based Cardiac Rehabilitation/telerehabilitation/rehabilitation," "Home Environment/Home Nursing/Community Health/community," and "nurs*". The search strategy is shown in [Appendix A](#). Additionally, we examined the computer-obtained reviews to see if the literature included in the reviews fulfilled our criteria in order to broaden the scope of the findings we retrieved.

2.3. Study selection

All the literature retrieved by the computer was imported into the Endnote X9 software for deduplication. Two researchers (TR and MX) independently screened the titles and abstracts according to the inclusion criteria. All papers that screened were favorably in the first step or where a decision could not be made had their full texts retrieved. Two researchers (TR and MX) manually searched relevant literature through full-text reading to determine their final inclusion. Any disagreement between the two researchers was discussed with a third researcher (LZ).

The inclusion criteria are as follows: 1) patients with heart failure, aged ≥ 18 years; 2) HBCR was conducted [12]; 3) nurse responsibilities are clear, including independence or assistance in the assessment, planning and guidance, and follow-up of HBCR; and 4) articles written in English or Chinese. The exclusion criteria are as follows: 1) unavailability of full text; 2) incomplete article; 3) review or case report; and 4) duplicate publications.

2.4. Charting the data

Our research aimed to explore the role of nurses in HBCR and the effects of nurses-coordinated HBCR. For this purpose, we focused on extracting the intervention procedures of nurses and outcomes from the literature. For each article reviewed, we also extracted information on authors, year, country, study design, study sample and the strengths/challenges/limitations of studies. The information was recorded in a Microsoft Excel file. Two researchers (TR and MX) extracted data independently and consulted with the third researcher (LZ) if there were discrepancies.

2.5. Collating, summarizing, and reporting the results

To characterize and summarize the results, a map of the data extracted from the included studies is presented in a tabular form. We presented authors, year, country, study type, sample size, duration of intervention, intervention operations of nurses, nurses' roles, materials used in interventions, outcome measures, main findings, and strengths or challenges of the studies. We carried out

detailed descriptions and analyses of intervention practices and outcomes to answer our research questions.

3. Results

A preliminary computer search yielded 1,165 articles and 4 protocols, of which 850 were left after deleting duplicate articles. In total, 789 articles that did not fit the inclusion criteria were deleted after reading titles and abstracts, and 61 articles were excluded after reading the full text. Two supplementary articles were manually searched. A total of 18 articles were finally included, including 15 randomized controlled trials [21–35] and three quasi-randomized controlled trials [36–38]. The literature screening process is shown in Fig. 1. The detailed characteristics of the included studies are in Table 1.

3.1. Patient assessment in nurse-coordinated HBCR

Patients with heart failure underwent a thorough evaluation before HBCR. Community nurses or cardiovascular specialist nurses can independently accomplish the comprehensive assessment of patients prior to HBCR, including assessment of physical condition and understanding the disease risk factors, psychological status, eating habits, and medication adherence of patients [27,31,35,37]. Two studies assessed patients' wishes [29,38]. A specialist nurse or rehabilitation therapist determined the patient's exercise tolerance through an incremental shuttle walking test and a 6-min walk test [24,26,28].

3.2. Planning and guidance in nurse-coordinated HBCR

Nurses often play an auxiliary role in exercise management in developing or adjusting exercise programs [31]. The at-home exercise program was designed in different ways. Nurses designed the program based on HBCR manuals or guidelines independently [21,23,25,29–32,35,37,38]; Nurses and rehabilitation therapists jointly developed the program [25–27,33,35]; The nurse agreed with the doctor and the head nurse [22]; Rehabilitation practitioners independently developed the guidance [28]; Patients chose exercise plans freely according to the manual [36]. Patients often participated in offline or online courses to master the basics of exercise before exercising at home [33,35,38]. More optional types of exercise are used at home than in the hospital [12]. Exercise at home typically takes the form of aerobic activity with resistance training as a complement. Aerobic exercise includes walking, stair climbing, chair exercise, cycling, gymnastics, lawn bowling, and even doing housework [21,22,25–28,31–35,38]. Anaerobic exercise is a weight-bearing exercise of the upper and lower extremities in which the patients can control the magnitude of the load with the help of water bottles or ergometers of different weights [21,22,25–28,32,33,35]. Exercise content includes 5–10 min warm-up exercise, 30 min aerobic exercise, and 5–10 min stretching exercise, and resistance exercise mostly involves aerobic exercise supplementary training [21,22,35]. Respiratory muscle exercises are also an important component of exercise rehabilitation [33]. Exercise is carried out at least 2–3 times a week, 20–60 min each time. Patients with good physical conditions could increase the

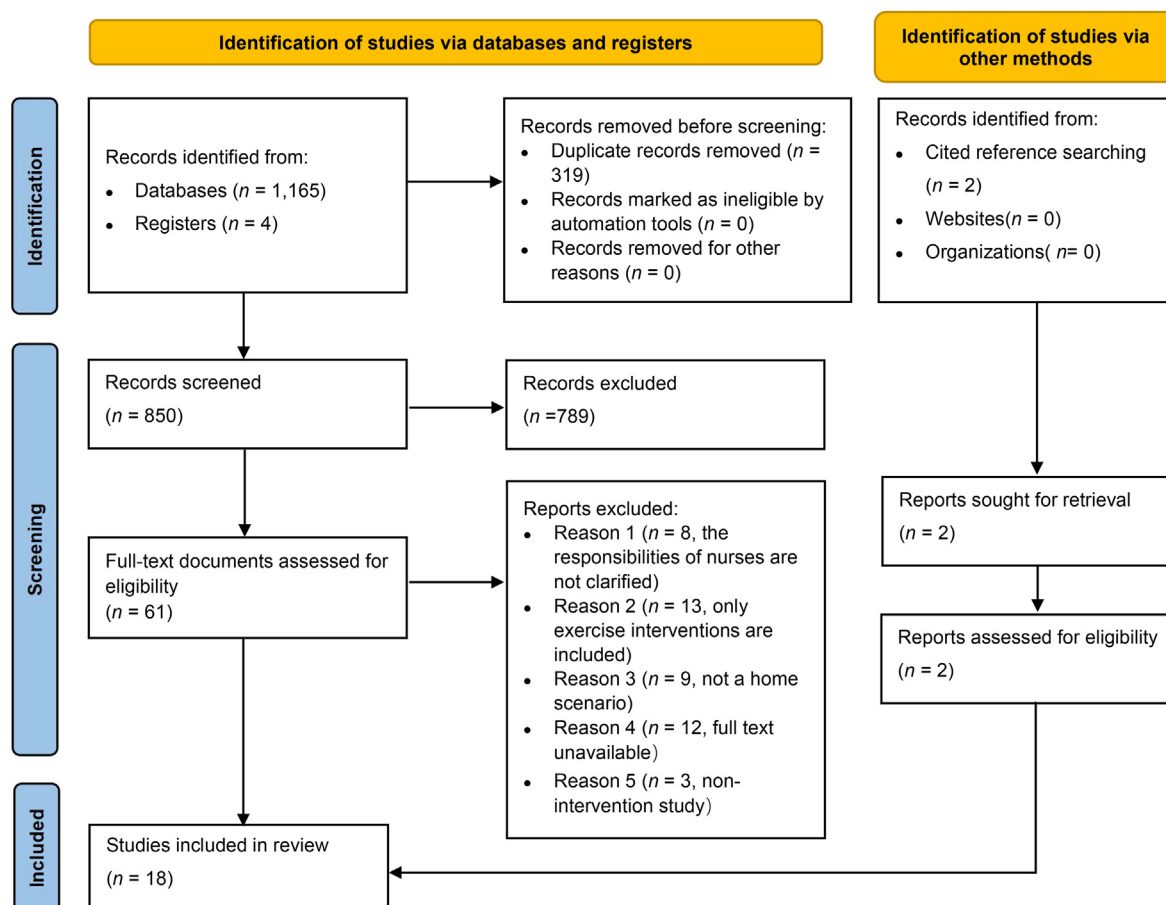


Fig. 1. Flow diagram of literature screening.

Table 1
The characteristics of the included articles.

Author, Year, Country	Study design, Sample	Time	Interventions by nurses			Nurse's role	Educational materials or remote devices	Outcome assessment and main findings	Strengths/Challenges/Limitations
			Assessment	Planning and guidance to patients	Follow up				
Cai et al., 2017 [21], China	RCT IG (n = 61) CG (n = 61)	8 M	Not mentioned	Health education (drug management, methods of self-monitoring and risk factors management). Exercise plan.	Method: Telephone.	Research nurses	Not mentioned	① 6MWD; ② LVEF; ③ MLHFQ; ④ Self-management ability scale for patients with heart failure. Findings: There was a significant improvement in all outcomes.	The intervention time was short.
Jian, 2019 [22], China	RCT IG (n = 41) CG (n = 41)	2 M	Not mentioned	Health education (knowledge, drug management, and risk factor management). Exercise plan.	Content: Rehabilitation status; Inform the precautions during exercise and give suggestions. Method: Telephone.	Research nurses	Not mentioned	① Self-management ability scale for patients with heart failure; ② 6MWD and LVEF. Findings: Improve the ability of self-management and exercise ($P < 0.05$).	–
Yu et al., 2014 [23], China	RCT IG (n = 78) CG (n = 78)	12 M	Not mentioned	Health education (symptom management for patients and caregivers, the importance of HBCR and exercise skills). Exercise plan.	Content: Psychological state, diet, and exercise, and make suggestions to monitor weight daily. Method: Home visits or telephone	Research nurses	Not mentioned	① LVEF, LVEDd and 6MWD; ② Body mass index, smoking status, blood pressure, lipid and blood sugar levels; ③ Continued recovery rates and hospital readmissions Findings: There was a significant improvement in all outcomes. Continued recovery rates (35% vs. 91%); Hospital readmissions (52% vs. 30%)	Follow-up improves patient adherence.
Arjunan et al., 2020 [24], India	RCT IG (n = 100) CG (n = 100)	3 M	Exercise assessment.	Health education (the knowledge of HF, diet, exercise, etc.).	Method: Telephone.	Research nurses	A guide to healthy living.	① MLHFQ and SF-36; ② Biophysiological measures included BMI, systolic and diastolic blood pressure, lipid profile, hemoglobin, random blood sugar, serum sodium, and potassium. Findings: Biomarkers and quality of life changed before and after the intervention.	Shorter follow-up periods limited change in outcome measures.
Bernocchi et al., 2018 [25], Italy	RCT IG (n = 56) CG (n = 56)	4 M	Not mentioned	Exercise plan.	Content: Collect disease-related information and provide advice on diet, drug and other healthy lifestyles. Method: Telephone.	Research nurses	① Testing equipment: oximeter and portable single-lead electrocardiograph; ② Pedometer and exercise diary.	① 6MWD; ② Time-to-event (hospitalization and death), dyspnea profile (PASE), disability (Barthel) and QoL (MLHFQ and CAT); ③ Safety outcome measures; ④ Loss to follow-up/intervention adherence Findings: IG maintained the benefits acquired at 6 months for outcomes ($P < 0.05$). In IG, the media time to hospitalization/death was 113.4 days compared with 104.7 in the CG ($P = 0.0484$, log-rank test).	This program is not suitable for patients with orthopedic problems.
Davidson et al., 2010	RCT IG (n = 53) CG (n = 52)	3 M	Cardiovascular condition, activity level, psychosocial situation and self-	Exercise plans and strategies of improving compliance	Content: Exercise assessment offline and self-manage assessment (Clinical	Research nurses	–	① All-cause rehospitalization; ② Cardiovascular admissions; ③	The sample size is small.

Table 1 (continued)

Author, Year, Country	Study design, Sample	Time	Interventions by nurses			Nurse's role	Educational materials or remote devices	Outcome assessment and main findings	Strengths/Challenges/Limitations
			Assessment	Planning and guidance to patients	Follow up				
[26], Australia			management influencing factors.	(behavioral prompts, diaries, etc.).	nursing specialists). Methods: Telephone and face-to-face.			Mortality; ④ MLHFQ; ⑤ Heart Failure Needs Assessment Questionnaire; ⑥ 6MWD; ⑦ NYHA. Findings: There was a significant improvement in all outcomes. Patients in the intervention group were less likely to have been admitted to hospital for any cause (44% vs. 69%, $P = 0.01$) or after a major acute coronary event (24% vs. 55%, $P = 0.001$). Participants in the intervention group were more likely to be alive at 12 months (93% vs. 79%; $P = 0.03$).	
Jepma et al., 2021 [27], Netherlands	RCT IG (n = 153) CG (n = 153)	–	Comprehensive geriatric assessment	Comprehensive nursing plan.	Content: Symptoms monitoring and drug management. Methods: Home visits.	Cardiovascular specialist nurses, research nurses and community nurses.	Not mentioned	① All-cause unplanned readmission or mortality within 6 months; ② the composite outcome at three and 12 months after randomization. ③ Recruitment rate; ④ Safety outcome measures Findings: It did not reduce hospital readmission or mortality within 6 months.	① The population is at high risk. ② The findings are influenced by health care policy.
Jolly et al., 2009 [28], UK	RCT IG (n = 84) CG (n = 85)	6 M	Exercise assessment.	Exercise plan. Health education about the knowledge of HF.	Content: Advice on self-management, symptom monitoring and drug management. Methods: Home visits or telephone.	Specialist heart failure nurses	Handbook on safety campaigns and self-monitoring.	① MLHFQ; ② Mortality, hospital admission; ③ HADS; ④ EQ-5D; ⑤ exercise capacity Findings: Psychological condition is improved.	The patient's remote movements cannot be monitored.
Lang et al., 2018 [29], UK	RCT IG: Patients (n = 25), Caregivers (n = 11) CG: Patients (n = 25), Caregivers (n = 10)	3 M	Patients' wishes.	Exercise plan.	Content: Stress management, symptom monitoring, and drug management. Methods: Home visits or telephone.	Research nurses	① REACH-HF manual; ② CD-ROM about relaxed and exercise; ③ Pedometer.	① Patients: MLHFQ and HeartQoL; clinical events (all-cause mortality, hospital admission; incremental shuttle walking test (ISWT); physical activity level (GeneActive accelerometry over a 7-day period); HADS; EQ-5D; SCHFI; healthcare utilization; and safety outcomes (serious adverse events). ② Caregivers: CBQ-HF; CC-SCHFI; Family Caregiver Quality of Life Scale Questionnaire; EQ-5D-5L; and HADS. Findings: There was a significant improvement in all indicators.	Studies focused on patients and their caregivers.
Ong et al., 2016 [30], USA	RCT IG (n = 715) CG (n = 722)	6 M	Not mentioned	Health education about the	Content: Symptom monitoring and drug management. Methods: Remote	Research nurses	① Health education manuals; ② Remote monitoring of equipment	① Readmission; ② all-cause mortality; ③ MLHFQ. Findings: There was a	Patient adherence is difficult to guarantee.

(continued on next page)

Table 1 (continued)

Author, Year, Country	Study design, Sample	Time	Interventions by nurses			Nurse's role	Educational materials or remote devices	Outcome assessment and main findings	Strengths/Challenges/Limitations
			Assessment	Planning and guidance to patients	Follow up				
Sun et al., 2022 [31], China	RCT IG (n = 50) CG (n = 50)	3 M	Comprehensive assessment.	management of HF. Exercise, diet, drug, psychological and risk factor management. Education about emergency treatment.	monitoring of equipment and Telephone. Content: Symptoms and weight monitoring; adjust the plan of exercise. Methods: Telephone and Smart Bracelet.	Specialist nurses	(transmission device, scale, blood pressure heart rate monitor). ① Smart Bracelet; ② E-learning materials in WeChat(Chinese social software).	significant improvement in MLHFQ. ① Heart rate (smart bracelet); ② Self-management scale for patients with heart failure; ③ 3-month readmission rate. Findings: Reduce resting heart rate, improve self-management ability, and reduce readmission rates (4% vs. 20%) (P < 0.05).	Research-based on smart devices.
Zhou et al., 2022 [32], China	RCT IG (n = 40) CG (n = 40)	12 M	Not mentioned	Physical activity, risk factors, medication, and nutritional management. Smoking-quitting monitoring.	Content: The completion of the exercise plan. Methods: WeChat.	Research nurses	E-learning materials in WeChat.	① The length of cardiopulmonary exercise tests, peak VO ₂ , the proportion of predicted maximum VO ₂ , 6MWD; ② SDS and SAS; ③ SF-36 Findings: Improve patients' exercise stamina (6MWD), reduce adverse emotions, boost patients' quality of life(P < 0.05).	① Remote supervision improves patient exercise adherence. ② The sample size is small.
Piotrowicz et al., 2022 [33], Poland	RCT IG (n = 425) CG (n = 425)	9 W	Not mentioned	Exercise, nutritional, lipid management. Smoking cessation. Vocational and psychosocial support. Methods of self-evaluate.	Content: Tele-ECG-monitored and supervised exercise training. Methods: Remote devices and telephone.	Research nurses	TR set (EHO mini device, blood pressure measuring and weighing machine) or implantable electronic devices.	① BDI-II score; ② peak VO ₂ ; ③ Recruitment rate and loss to follow-up/intervention adherence. Findings: Improve physical capacity (P < 0.05).	① The intervention was shorter. ② The results cannot be fully extrapolated to the female population.
Zhu et al., 2021 [34], China	RCT IG (n = 48) CG (n = 52)	—	Psychosocial assessment.	Health education about the knowledge of HF. Exercise management.	Content: Symptoms monitoring. Methods: Telephone.	Research nurses	HBCR manual.	① Herth hope index; ② NYHA and 6MWD; ③ SF-36. Findings: Improve the level of hope, cardiac function and quality of life (P < 0.05).	Pay attention to the patient's psychology.
Peng et al., 2018 [35], China	RCT IG (n = 49) CG (n = 49)	2 M	Not mentioned	Self-care instruction and psychological instruction.	Content: Discussions about the current situation and problems; support and resources; answers to questions; and referral services as needed. Method: WeChat or QQ (Chinese social software) or telephone.	Research nurses	Health education manuals.	① MLHFQ; ② 6MWD; ③ HADS, ④ LVEF, HR and NYHA; ⑤ Safety outcome measures; ⑥ Loss to follow-up/intervention adherence Findings: There was a significant improvement in MLHFQ, 6MWD and HR.	① The intervention time was short. ② More outcome measures should be considered
Nakayama et al., 2020 [36], Japan	Quasi-randomized controlled trial Blank (n = 137) Outpatient CR (n = 69) Tele CR (n = 30)	5 M	Not mentioned	Not mentioned	Content: Symptom monitoring, exercise management, and quality of life. Methods: Telephone.	Specialist heart failure nurses	DVs for HBCR guidelines.	① The emergency readmission rate; ② EQ-5D; ③ Loss to follow-up/intervention adherence Findings: The outpatient CR group (n = 69), the emergency readmission rate within 30 days of discharge	The pandemic will motivate patients to participate in tele cardiac rehabilitation.

Table 1 (continued)

Author, Year, Country	Study design, Sample	Time	Interventions by nurses			Nurse's role	Educational materials or remote devices	Outcome assessment and main findings	Strengths/Challenges/Limitations
			Assessment	Planning and guidance to patients	Follow up				
Feinberg et al., 2018 [37], USA	Quasi-randomized controlled trial (n = 21)	1 M	Comprehensive assessment(home health nurses).	Not mentioned	Not mentioned	Community nurses	Recommended tools for self-management of exercise, diet, etc.	was lower in the remote CR group (n = 30) than in the non-CR group (n = 137) (P = 0.02). ① Self-Care of Chronic Illness Index; ② Heart Disease Fact Questionnaire; ③ SCHFI; ④ Loss to follow-up/intervention adherence Findings: There is a statistically significant increase in the self-care management subscale (P = 0.002). Patients: ① MLHFQ; HeartQoL; ② Health Literacy Questionnaire; ③ clinical events; ④ HADS; ⑤EQ-5D; ⑥SCHFI; ⑦ safety outcomes (serious adverse events). Caregivers: ① CBQ-HF; ② CC-SCHFI; ③ Family Caregiver Quality of Life Scale Questionnaire; ④ EQ-5D; ⑤ HADS. Findings: There was a significant improvement in all indicators.	Interviews were used to gain insight into patient and physician perspectives on cardiac rehabilitation.
Purcell et al., 2023 [38], UK	Quasi-randomized controlled trial Patients (n = 124) Caregivers (n = 46)	3 M	Patients' wishes.	Health education. Exercise plan.	Content: Stress management, symptom monitoring, and drug management. Methods: Home visits or telephone.	Research nurses	① REACH-HF manual; ② CD-ROM about relaxed and exercise; ③ Pedometer.	COVID-19 affects tests of athletic ability.	

Note: 6MWD = 6-min walking distance. BDI-II = Beck Depression Inventory II score. CAT = chronic obstructive pulmonary disease (COPD) Assessment Test. CBQ-HF = Caregiver Burden Questionnaire for Heart Failure. CC-SCHFI = Caregiver Contribution to Self-Care of Heart Failure Index Questionnaire. CG = control group. EQ-5D = EuroQol five dimensions questionnaire. EQ-5D-5L = 5-level EQ-5D version. HADS = Hospital Anxiety and Depression Scale. HR = heart rate. IG = intervention group. ISWT = incremental shuttle walk test. LvEDd = left ventricular end-diastolic dimension. LVEF = Left Ventricular Ejection Fraction. M = month. MLHFQ = Minnesota Living with Heart Failure Questionnaire. MRC = Medical Research Council. NYHA = New York Heart Association. PASE = Physical Activity Scale for the Elderly. QoL = quality of life. RCT = randomized controlled trial. SAS = Self-rating Anxiety Scale. SCHFI = Self-Care of Heart Failure Index Questionnaire. SDS = Self-rating Depression Scale. SF-36 = Survey Short Form-36. VO₂ = oxygen uptake. W = week.

number of exercises [21–23,25,34,35]. Exercise intensity does not exceed 70% of the target load [21]. Home-based exercise focuses on safety and adherence management. Some studies provided remote monitoring devices for patients to wear during exercise to ensure safety and implementation [25,31,33]. When symptoms such as chest tightness, dizziness, and shortness of breath occur during exercise, patients should immediately stop exercising and call to inform medical care [35].

Nurses mainly facilitate patient education. Nurses provided face-to-face education [23,24,28,30,33,35], education online [31,32,35], or instructional materials (instruction manual, video materials explaining moves, or DV to relax emotions) that could be taught again [21,22,29,31,32,35,38]. The educational contents of HBCR for patients with heart failure involve the following aspects: 1) knowledge of heart failure [24,28–30,34–38]; 2) self-monitoring methods, such as keeping a sports diary, measuring blood pressure and heart rate, and using remote monitoring equipment [21,23,28,30,33]; 3) correct exercise, such as recommended exercise methods, explanation of exercise movements, and danger precautions [23,24,29–33,36,37]; 4) reasonable diet [23–25,29–33,37]; 5) standardized medication [21,24,25,29–31,37]; 6) psychological counseling methods, such as listening to music, confiding in family, and asking for professional help [23,29,31,33,35,37]; and 7) identification of potentially dangerous events, such as the weight gains more than 2 kg in a

week [23,29–32,36]. Some studies have focused on weight monitoring [23,30], lipid management [33], and smoking cessation [32,33]. Some studies also educated caregivers of patients with heart failure [29,38].

3.3. Follow-up in nurse-coordinated HBCR

Nurses conducted a dynamic assessment of patients with heart failure through remote monitoring and patient self-reporting. Remote monitoring devices include trackers (e.g., pedometers and smart bracelets), scales, blood pressure and heart rate monitors, oximeters, and portable lead electrocardiograms [25,29–33,38]. Data on signs can be transmitted to the research center for daily checking by nurses. The nurse would contact the patient for any abnormality or alarm value as soon as possible for treatment [30,33].

Patient-reported outcomes were obtained through home visits by nurses [23,27,29,38], telephone follow-ups [21–25,29–31,33–36,38], some social software [31,32,35], or self-diaries of symptoms and exercise [25,29,38].

Nurses mainly focused on five topics in the follow-up: symptom perception (e.g., dyspnea, edema, and fatigue), medication adherence, low-salt diet, psychological counseling, and the completion of the exercise plan [27,29,31–36,38]. Nurses provide suggestions on health behavior management [30,38], prescriptions for drug dose

adjustment [28], and symptom treatment or referral to doctors [26]. The frequency of remote follow-up visits was mostly once per 1–2 weeks for 40–45 min each time [22,25]. In addition, Davidson conducted exercise follow-ups in patients with heart failure using offline assessments, and the patients were asked to perform a 6-min walk trial five times a week in a designated place to allow the research team to assess the patient's exercise status [26].

3.4. Safety events of nurse-coordinated HBCR

None of the 18 studies reported cases of heart failure exacerbations due to participation in HBCR. Six studies reported no serious adverse events in the home-based cardiac rehabilitation intervention trials but did not specify the serious adverse events involved [25,27,29,30,35,38].

3.5. Feasibility and acceptability of nurse-coordinated HBCR

Most studies reported considerable outcomes of feasibility or acceptability of intervention trials. Five studies reported good participant recruitment [26,27,29,30,33,38]. However, Jepma stopped recruitment early during the recruitment period due to changes in national public health strategies that made it impossible to compare the intervention and control groups [27]. Purcell showed that their recruitment was not ideal. The interviews found that this finding can be attributed to two reasons. First, some patients with longer disease and younger patients have little interest in exercise programs. Second, some patients have barriers to the use of remote technology [38].

Eleven studies reported attrition or adherence to intervention trials, with study loss of less than 20% and intervention adherence of more than 50% [23,25,26,28–30,33,35–38]. Three studies reported patients' high willingness to continue recovery [23,36,37]. Two studies reported participants' satisfaction or experience with study participation [29,37]. Lang reported good results in participating in HBCR by conducting a binary intervention with patients with heart failure and their caregivers and semi-structured qualitative interviews with 15 patients and 7 caregivers to determine their experience of participating in HBCR [29]. Feinberg reported positive attitudes toward lifestyle changes from patients with heart failure and their caregivers [37]. From healthcare providers' perspective, the HBCR provides patients and healthcare professionals with an interdisciplinary and integrated care strategy [37].

3.6. Efficacy of nurse-coordinated HBCR

The included studies described the effects of HBCR interventions on cardiac function in people with heart failure [21–23,26,31–35], and the results indicate that activity endurance [21–23,25–27,29,32–35], quality of life [21,24–27,29,30,32,34–36,38], self-care/management [21,22,26,27,29,31,37,38], hospital readmissions or mortality [23,25,26,29–31,36], psychological states [27–29,32–35], the indicators related to heart failure risk factors [23,24], needs [26], and nursing staff burden [24,29,38] were improved.

Two studies reported that improvements in patients' psychological states were not significant [35,38]. This phenomenon may be related to a low baseline level of the patient's depression scale score and a lack of face-to-face interaction between the doctor and the patient. However, the outcome measures in the two studies were not satisfactory [27,28]. One study noted a few differences between the control and trial groups because of changes in local healthcare policies that led to increased participation in healthcare [27]. The other study had less follow-up supervision of patients and was unable to ensure the execution of the patient's exercise plan

[28]. Thus, it is important to motivate patients to adhere to the given instructions.

4. Discussions

This scoping review examined 18 articles to summarize the contents and effects of HBCR coordinated by nurses for patients with heart failure. Nurses play an important role in patient assessment, planning, guidance, and follow-up. Nurse-coordinated HBCR is beneficial for patients with heart failure.

Nurse-coordinated HBCR is a multidisciplinary comprehensive management strategy, which is reflected in the diversity of aspects involved and the diversity of participants. The aspects include patient assessment, exercise management, diet management, medicine management, and psychological consulting. The patient assessment mainly includes the physical condition, psychological condition, and living habits. Exercise management is the core of HBCR [12]. Nurse-guided exercise mainly involves aerobic exercise and resistance exercise. Both parameters could improve cardiorespiratory function, reduce muscle weakness, and increase serum anabolic steroid concentrations [1,39,40]. Health education is the main way to spread correct behavior of self-management in the HBCR coordinated by nurses [41]. The content of education is comprehensive and includes diet, medicine, psychological, and risk factors management. The form of health education is no longer constrained by time or place because of the extensive growth of the internet [31,32]. Nurse-led home education can reduce readmissions for patients with chronic diseases [42]. In addition, the HBCR coordinated by nurses focuses on the "dual" intervention of patients and their family members [29,38]. The family environment is important for the disease management of patients with heart failure, and family-based education has more clinical and social benefits than patient education alone [43].

The nursing-coordinated intervention for HBCR of patients with heart failure is dynamic. During the HBCR period, patients need to be monitored and followed up remotely, and researchers dynamically adjust the exercise mode, time, and intensity according to the patient's disease and physical exercise endurance. Bernocchi set up a two-stage exercise plan [25]. The patient's exercise program at the foundational level stage included 15–25 min of weightless strength training, 30 min of gymnastics, three times a week, and two days of free walking. In the high-level stage, the patient's exercise regimen consisted of 30–45 min of mini manometer training with increments from 0 to 60 W and 30–40 min of weight-bearing (0.5 kg) walking, 3–7 times per week. In order to save human resources while ensuring the stability of the patient's symptoms, nurses dynamically adjust the content of health education and follow-up time in accordance with the trajectory of the patients' discharged disease status from the vulnerable period to the stable period.

Nurse-coordinated HBCR for patients with heart failure is holistic and continuous. Nurses participate in the whole process of HBCR of patients with heart failure and have an overall grasp of the patient's situation and condition changes. After receiving the patient's information, nurses perform grading processing and directly provide treatment advice for the management of mild symptoms or simple consultations [27]. For situations beyond the scope of ability, nurses promptly hand over the task to the doctor or rehabilitation therapist.

Safety is one of the keys to the successful application of HBCR for heart failure patients. In this study, no trial in patients with heart failure involved significant safety risks. In 2019, experts issued a statement that cardiac rehabilitation is safe [12]. In one study, no significant difference was observed in mortality or incidence of adverse malignant cardiovascular events between patients

receiving HBCR and outpatient cardiac rehabilitation [44]. Although “serious adverse events” have not been reported, the HBCR of patients with heart failure still needs to focus on patient safety. Remote symptom monitoring systems (vital signs monitors and crisis alarms) can provide early warning information for patients and medical staff in a timely manner to ensure patient safety [25,33].

Nursing-coordinated HBCR is feasible and acceptable. This intervention transcends time and space limitations and facilitates disease management in patients with heart failure [13]. In the context of regular epidemic prevention and control, “staying at home” means protecting vulnerable people. Due to the pandemic, the number of people who chose to participate in tele cardiac rehabilitation rose from 19% to 69% [36]. However, adherence gradually decreased over time; for instance, Jolly adhered to exercise at 20 weeks of intervention, and only 54% of patients adhered to exercise [28]. Adherence is a major difficulty in remote intervention. The investigators could not ensure that patients could complete all rehabilitation programs. Though telephone supervision can effectively improve patient adherence, it does not result in a substantial benefit [30]. This condition can be improved with the help of apps or wearables [29,31]. The best solution is to change the patient’s mindset and build a strong internal drive. Follow-up studies should focus on patient intervention compliance and strengthen the supervision and follow-up mechanism.

Nurse-coordinated HBCR can improve the heart function and psychological condition of patients with heart failure. Exercise in HBCR intervention is beneficial for the changes in patients with heart failure, which can improve skeletal muscle strength and endurance in patients, reduce sympathetic excitability, and provide a means for heart failure prevention and prognosis [45,46]. Health education can help patients become aware of risk factors for developing heart failure, such as smoking, obesity, and depression, which can lessen the strain on the myocardium and delay the onset of heart failure [47,48].

The development of e-health will accelerate the development of HBCR coordinated by nurses. Nurses can use mature online social media to publish health education materials and interact with patients remotely [31,32,35]. However, this platform may also become an obstacle to pushing through HBCR, which is related to the fact that some older people are unfamiliar with these electronic devices and poor network service [38,49]. Therefore, the electronic literacy of patients with heart failure needs to be considered.

HBCR programs lack assessment of patient needs. Only 17% of the interventions in this study proposed a plan based on the patient’s wishes, and one interview showed that the patient still had unmet needs. Needs assessment quantifies the difference between patient expectations and reality for participation in HBCR and is useful in identifying targets for rehabilitation programs [50]. The Cardiac Rehabilitation Inventory and the Belief About Cardiac Rehabilitation have been used to measure the need and willingness of cardiovascular patients to participate in cardiac rehabilitation [51]. However, they are less frequently utilized in heart failure patients and lack a home-based component.

The potential of nurses to help patients with heart failure exercise at home needs to be realized. The exercise program in HBCR for patients with heart failure is mainly undertaken by rehabilitation engineers supplemented by nurses. As the main interventionists, nurses have achieved good results in participating in the exercise in patients with heart failure. However, some studies have coordinated unsatisfactory effects or low extrapolation of conclusions due to small sample sizes and the influence of the COVID-19 pandemic [52].

Studies about the HBCR lack evaluation standards, especially in the cost-effectiveness system. HBCR outcomes were diverse, and

the selection of outcome measures varied between studies. Exercise capacity and quality of life are commonly used as effectiveness markers, although the measurement techniques used vary. Most studies did not consider socioeconomic outcome, which is a contributing factor to patient participation and key to sustainable healthcare activities by healthcare workers [53].

5. Implication

In summary, some improvements need to be made in the HBCR coordinated by nurses. In the future, medical staff need to pay attention to patients’ e-health literacy to promote the development of medical convenience. Medical staff need to pay attention to the patient’s compliance change and establish the patient’s own motivation to change and maintain it. HBCR needs assessment tools can be explored from the perspective of patients, a comprehensive assessment system for patients with heart failure can be constructed, and demand-oriented personalized intervention plans can be designed. Further studies are required to explore the potential of nurses in rehabilitation care. Finally, researchers should explore the best evaluation criteria for HBCR of patients with heart failure and formulate effective and economical home cardiac rehabilitation programs for these patients.

6. Limitations

Although the role of nurses is important in HBCR for patients with heart failure, this study has some shortcomings. First, the review searched only English and Chinese publications, and only one entry for grey literature. The search time was set to start with database creation to compensate for as much as possible. Second, this review aimed to provide a comprehensive overview of the relevant literature; thus, no quality assessment of the literature was carried out. Future studies can further include literature in multiple languages for quality evaluation and comparison and provide diversified suggestions for the management of heart failure diseases. Third, we included studies that rarely described the fidelity of the intervention and had some limitations in sample size and intervention timing. Future researchers can invest more time and effort in this area to further confirm that home-based cardiac rehabilitation for heart failure patients with nurse collaboration is positive and meaningful.

7. Conclusion

Assessment, planning and guidance, and follow-up for heart failure patients in HBCR could be handled by nurses in secure, acceptable, and effective manners. HBCR for patients with heart failure in most developing countries remains in its infancy. Nurses can focus on needs assessment and adherence management for patients with heart failure. The electronic literacy of patients needs to be focused on. Nurses need high-quality evidence on the potential of exercise. In order to promote the development of HBCR and advance the nursing field, senior or advanced practice nurses should participate in designing the HBCR system.

Ethical statement

Not applicable.

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Data availability statement

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

CRediT authorship contribution statement

Tiantian Ruan: Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Project administration. **Mengqi Xu:** Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing – review & editing, Project administration. **Lingyan Zhu:** Conceptualization, Methodology, Validation, Formal analysis, Resources, Writing – review & editing, Supervision, Project administration. **Yuan Ding:** Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing – review & editing.

Declaration of competing interest

The authors have declared no conflict of interest.

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Appendices. Supplementary data

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